

Jefferson Manuscript Draught of the Declaration of Independence in the Library of the Society."

By Mr. S. F. Peckham, "The Genesis of Bitumens, as Related to Chemical Geology."

Pending nominations Nos. 1432 and 1451 to 1457 and new nominations Nos. 1458 to 1464 were read.

The Society was adjourned by the presiding member.

NOTES ON KANSAN DRIFT IN PENNSYLVANIA.

BY PROF. EDWARD H. WILLIAMS, JR.

(Read April 1, 1898.)

The writer uses the terms Kansan and Wisconsin to represent respectively the furthest ice advance and the first great moraine of recession which was delimited by Lewis and Wright, without accepting the differences in age claimed by some authorities. His work since 1893 has been a study and mapping of the Kansan deposits in this State, and papers have been published from time to time, copies of which have been deposited in the library of this Society.

At the Buffalo meeting of the American Association for the Advancement of Science, in 1896, the writer presented a few notes on the work of the preceding months and claimed that the ice which covered the northern part of this State originated at two centres, an eastern and a western, as the lithological burden on either side of the apexes of both Kansan and Wisconsin deposits differed widely in character, kinds and amount of crystalline and clastic material. This claim was further substantiated by the fact, shown in the sketch accompanying this paper, that the apex of the earlier line of drift had been overridden by the latter, while, had the latter been a moraine of recession only, there should have been a continuous Kansan border.

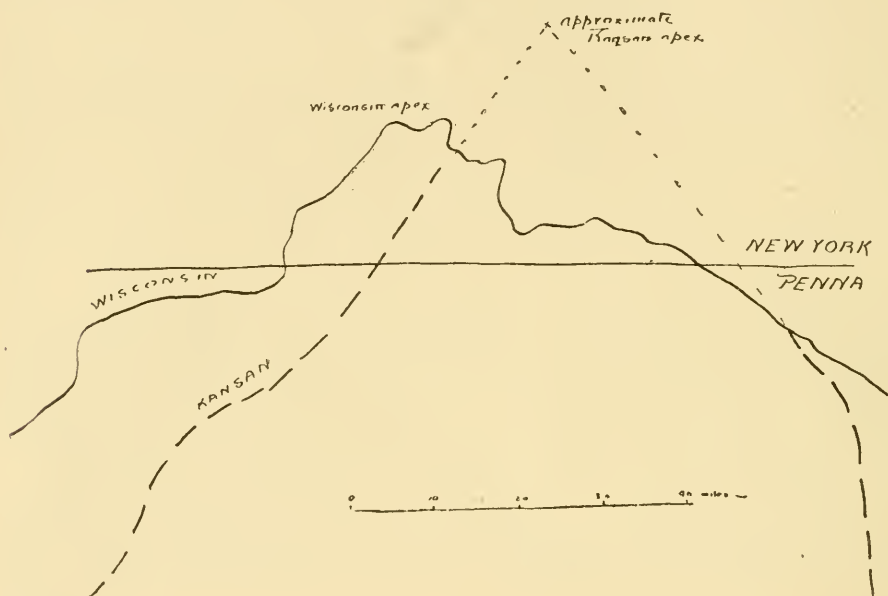
To these claims the writer now wishes to add two more. First, that the powers of the two bodies of ice on either side of the apex were unequal, as the eastern Kansan border will average thirty

miles in width, while the western averages but six. This is in accordance with the deductions of the late Prof. James D. Dana, in the last paper he wrote on glaciation, in attempting to account for the wide difference between the eastern and western deposits. It is well known that Mr. Upham began his work in the east and held to the theory of a single glacial epoch. After work in the west he accepted that of two or more periods. On his return to the east he returned to his first opinion. This is an epitome of the wide difference in appearance between the few strong moraines of the east and the multiplicity of the deposits of the west, and Prof. Dana theorized that such difference must have been caused by the abundant precipitation of the east and the scanty precipitation of the west, so that the deficit of dry seasons would bear a smaller proportion to the total precipitation in the east than in the west, and the strength and persistence of the ice at certain latitudes in the east would be balanced by the many fluctuations of the west. The strength thus predicted for the eastern glacier is shown by the wider margin found and by the variation in the position of the apex. While the western Kansan ice retreated to the position taken by the Wisconsin margin, the relaxation of the pressure was accompanied by an advance of the eastern ice across the region of the apex.

The second claim for a double origin substantiates the theory, as there was found in the summer of 1897, at East Warren, Pa., forty feet below the original surface and 100 feet above the water of the Allegheny river, a rolled piece of native copper as long and thick as the finger, in a lenticule of dense till which resisted the pick. The matrix of clay had preserved the copper from oxidation to such an extent that its surface was still smooth, and with it were found fresh rolled and glaciated crystalline pebbles and local angular clastics. This lenticule was about 120 feet above the rock surface, as shown by a neighboring well section, and the original thickness of glacial deposit was thus 160 feet. This find shows that the western ice traversed the region of the great lakes in a southeastern direction and proves that we had a meeting of two ice sheets near Salamanca, N. Y. The variations in strength and the varying number of moraines of the eastern and western glaciers are thus satisfactorily settled in a simple manner. It remains to say that the writer was unaware at the time he first made the claim for two origins that Prof. Wright had surmised the same (*Ice Age*, p. 443) from the symmetry of the moraine delimited by Mr. Lewis and

himself with respect to origins near Lake Superior and Labrador. It was a surmise only, as he states that these need not have been origins, and the ice may have traversed them from some more northern point. The first distinct proof of such difference of origin rests with the writer.

This glacial deposit of East Warren disposes, also, of another question which has been much debated, whether there was more than one ice age.



The writer has already disposed of the question for eastern Pennsylvania, by showing that the Lehigh and its tributaries acquired their present level in pre-Kansan times. The lenticule at East Warren was about 100 feet above the present Allegheny; but the rock floor, as shown by a well section near, was 120 feet below the lenticule, or twenty feet below the present Allegheny. Other well sections show that this floor is dipping steeply and toward the west, so that it reaches greater depths below the present river level. This lenticule was forty feet below the old surface at this point; but this surface rose on going west, so that in a distance of fifty feet it was sixty feet higher. On this old surface the various geologists have collected material and all agree that it represents the oldest glacial period. This surface is one of the alleged "rock shelves" of the region; but is instead a dump in slack water and shown by well sections to be over 250 feet thick. It is allowed by all that

the surface consists of Kansan drift, and it is also allowed that this surface was last deposited. It follows, therefore, that the earliest, or Kansan, drift was deposited after the Allegheny river had reached its present level. This is but one of hundreds of similar cases found for 200 miles along the Allegheny, and with streams under both glaciers—eastern and western—cut to present levels pre-glacially, the great antiquity of the ice age falls.

It may be asked, however, how the reversal of streams and cutting of cols are disposed of, as these are matters of considerable certainty.

When we consider that the ice advanced up stream in all cases over the northern Allegheny region, we can see that extreme high water would obtain and the water would pour over the cols into adjacent systems long before the actual presence of the ice at the spot. In fact, the actual presence at a given spot is unnecessary. If we next consider that the advancing ice would confront the loftiest part of our highlands, we can see that it would be aided in its efforts to produce high water by a large snow cap whose ablation would produce torrential conditions in all the drainage systems, and fill those systems with local trash, more or less rolled, which would saw down the cols over which the empounded waters escaped, long before the ice reached the region, and that when the glacier did make its appearance it would discharge into abnormally deep water. We have thousands of evidences from the north to the south of the State, in elevated beach lines, and similar remains, that the water exceeded 1600 feet above tide, and only on the highest mountain tops do we find unmodified till. In all other cases it is ordinary overwash or slack water modifications. The dead slack of the original water is shown throughout the region by the clean iceberg clay which sometimes reaches 100 feet in depth, and underlies all other deposits.

The matters touched upon here will be more fully discussed in the final report of the survey.